

Overview

In Baltimore on 13–15 March 1991 the International Symposium on “M³D: Mechanics and Mechanisms of Material Damping” took place. The Symposium was sponsored by the ASTM Committee E28 on Mechanical Testing in cooperation with the Office of Naval Research. More than 69 colleagues representing several countries participated. The main objective of the Symposium was to bring about a synergistic interaction among researchers in the field of mechanics of solids and materials science, with the aim of promoting increased collaboration between the two disciplines. In retrospect, and judging from the comments made by many of the participants during and after the meeting, the organizers of the Symposium feel that the objective was well met.

Within the two and a half days’ duration of the Symposium there were five technical sessions. Each session was under the control of two specially invited Session Chairmen and started with a keynote address given by an internationally recognized authority in a particular aspect of damping. The keynote address was then followed by several contributed talks. The Session Chairmen ensured that ample time was available for questions and discussion as an integral part of each talk. The discussions were judged to be particularly valuable. In addition to these five technical sessions, and due to the overwhelming response from the call for papers, the Organizers arranged a Poster Session at which around twenty colleagues set up displays detailing the latest results of their research on many aspects of damping. The Poster Session allowed ample time for researchers to get acquainted, or, in many cases, re-acquainted. This session also allowed the participants the opportunity to grasp a better understanding of the varied techniques used for damping measurements and to develop ideas for future research.

As a record of the International Symposium on M³D we have produced this Special Technical Publication (STP). It is comprised of 35 papers which cover a wide range of aspects of damping, from fundamental work to technological applications. There were five invited keynote speakers who led off the sessions of the Symposium and whose efforts were focused on highlighting the complementary roles of *mechanics* and *materials* in our understanding of damping phenomena. The first five papers in the STP are their keynote papers. Most of the authors contributing to the STP are affiliated with universities or national laboratories, but two representatives are from industry. The international interest in damping is reflected in the fact that authors from eight countries contributed to the STP. Although most of the papers had a natural bias to either mechanics or materials, many of the papers point up the necessity of merging these disciplines for advances in understanding damping.

That damping is a complicated phenomenon can be judged by the breadth of the mechanics and materials topics that are covered in this STP: thin-layer materials, high damping materials, metal matrix composites, ceramic matrix composites, polymer matrix composites, phase changes (including martensitic phase changes and solid-liquid phase changes), non-linear effects of boundaries, coupled modes of vibration, magnetomechanical damping, thermoelastic damping, finite element modeling, specific materials (tungsten carbide-cobalt, aluminum, spinels, niobium, tantalum, zircon, rubber, zirconium-niobium, carbon-carbon, superalloys, silicon carbide-vitroceraamics, steels, and aluminum-silicon), grain boundary effects, and longitudinal and flexural vibrations. (One wonders what does NOT affect damping!).

The keynote paper by Berry emphasizes the power of damping measurements in understanding and controlling the mechanisms of damping at the atomic level in a variety of

materials that will be of great technological impact, including the new superconductors with high critical temperatures. Professor de Batist's keynote paper is on the subject of the role of martensitic phase transformations in promoting high damping in alloy systems. The keynote paper by Kolsky covers the history of the development of techniques for measuring damping over many orders of magnitude of frequency. Some innovative nontraditional applications of damping measurements were the subject of the keynote paper by Professor Gibson. Finally, the fifth keynote paper by Wong and Holcomb deals with some aspects of the mechanics of damping in ceramic reinforced metals.

Readers who are interested in the history of the development of techniques for measuring damping will appreciate the keynote paper by Kolsky and the invited paper by Plunkett. In particular, the Kolsky paper has an ample supply of references. Other papers, such as that by Lesieutre, start with the traditional tools of mechanics (for example, finite element modeling) and lead to suggestions for critical measurements for determining mechanisms of damping. A few papers attack the problems of getting exact solutions for specific aspects of flexural vibrations or coupled modes of vibration.

For the future, much research is left to be done. For all the techniques of measuring damping, the availability of standard reference materials with known values of damping (for specific vibrational mode and frequency) is going to be essential for assessing accuracy of damping values.

The organizers of the Symposium have had lots of help from many sources. Truly the team spirit is alive in the damping field! We express our appreciation to: the ASTM staff for their efforts in promoting the Symposium, in having the arrangements at the location run so smoothly, and in providing the infrastructure for getting this STP available in print; the Session Chairmen for being firm but diplomatic in running their sessions punctually and for sparking lively discussions; the invited keynote speakers for permitting us to peek into their vast reservoir of expertise on damping gained over many years; the participants from overseas for providing the international flavor; our network of anonymous reviewers for their time and most helpful suggestions for improvements in many of the manuscripts (each manuscript was reviewed by three reviewers); our colleagues in Committee E28 for their enthusiasm in backing the Symposium; the Office of Naval Research, represented by Dr. Don Polk, and Ms. Cathy Wong, for its interest and sponsorship of the Symposium.

As a final note, as organizers of the Symposium and editors of the STP, we admit reluctantly that we have enjoyed all the hustle and bustle associated with this activity. Many hours of our time went into seeing that things were done correctly and on time. We thank our families for putting up with us!

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